DOCUMENT RESUME

ED 477 323 SE 068 061

TITLE	A Watered-Down Topographic Map. Submarine Ring of Fire--Grades 6-8. Topographic and Bathymetric Maps.
INSTITUTION	National Oceanic and Atmospheric Administration (DOC), Rockville, MD.
PUB DATE	2002-00-00
NOTE	11p.
PUB TYPE	Guides - Classroom - Teacher (052)
EDRS PRICE	EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS	Curriculum Design; Earth Science; Lesson Plans; *Map Skills; *Marine Education; Measurement; Middle Schools; *Oceanography; Science Activities; Science Instruction; Teaching Methods; Visualization
IDENTIFIERS	*Topographic Maps

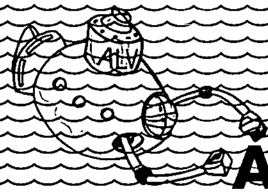
ABSTRACT

This activity is designed to teach about topographic maps and bathymetric charts. Students are expected to create a topographic map from a model landform, interpret a simple topographic map, and explain the difference between topographic and bathymetric maps. The activity provides learning objectives, a list of needed materials, key vocabulary words, background information, day-to-day procedures, internet connections, career ideas, integrated subject areas, evaluation tips, extension ideas, and National Science Education Standards connections. (KHR)

A Watered-down Topographic Map

Submarine Ring of Fire – Grades 6-8
Topographic and Bathymetric Maps

National Oceanic and Atmospheric Administration
U.S. Department of Commerce



A Watered-down Topographic Map

Focus Question

How does one create a topographic map and what are the differences between topographic maps and bathymetric charts?

Grade Level

6 - 8

Focus Question

How can a two dimensional map be created which shows both the vertical and the horizontal shape of the land?

Learning Objectives

Students will be able to create a topographic map from a model land form.

Students will be able to interpret a simple topographic map.

Students will be able to explain the difference between topographic and bathymetric maps.

Materials per Group of Four Students

- ❒ One-liter beaker or container for water
- ❒ 500-700 ml of water
- ❒ Funnel
- ❒ 10 cm ruler; the ruler can be easily made by photocopying rulers on an overhead acetate and cutting them to the size needed
- ❒ Overhead projector acetate
- ❒ Felt tip marker
- ❒ 12 inches of masking tape
- ❒ Scissors
- ❒ Rocks or other objects - Enough crushed rock to fill a one-liter beaker to a height of six inches, river rock cobbles, or self-created clay mountains and/or valleys can be used. The criteria for selection is at least one fairly flat-bottom side with the remainder of the rock having interesting features and topographic possibilities, such as steep and gentle slopes, valleys, twin peaks, and an overall height of at least seven centimeters.
- ❒ Container - the rock(s) must fit completely inside the container and not protrude past the top of it.
- ❒ Analysis Worksheet
- ❒ Procedure Sheet

Audio/Visual Equipment

Overhead projector

Teaching Time

One to two 45-minute periods

Seating Arrangement

Cooperative groups of up to four students

Maximum Number of Students

Limited by materials only

Key words

Topographic
Bathymetric
Contour line
Contour interval
Relief
Elevation
Depth

Background Information

Topographic maps are tools used by many people. Anyone in need of knowing their position on Earth in relation to surrounding surface features may use a topographic map to understand this relationship.Geologists, field biologists, and hikers are just a few who use topographic maps. While the use of a Global Positioning Satellite (GPS) receiver can give one their exact location on Earth and even the direction and how far away one is from another location, it does not tell one that there are rivers, canyons, and steep mountains along the suggested direct route. A topographic map does. Advancements in computer applications and computer processing speed provide even newer uses for topographic maps. Overlaying a computer-generated topographic map of a river watershed onto a computer-generated local county, city, and highway map allows emergency planners to create virtual flooding events to see which roads, bridges, and buildings would be most affected.

A topographic map is a two-dimensional map portraying a three-dimensional landform. Visualization between two dimensions and three dimensions, a skill used in many other fields, can be a difficult process for some people. Interpreting topographic maps provides practice in this skill.

Contour lines are imaginary lines connecting points between places of the same elevation. A contour interval is the predetermined elevation difference between any two contour lines. A contour interval of 100 feet means that the slope of the land has risen or declined by 100 feet between two contour lines. A map that shows very close contour lines means the land is very steep. A map that has wide spacing between contour lines has a gentle slope. The smaller the contour interval, the more capable a map is of depicting finer features and detail of the land. A contour interval of 100 feet will only pick up detail of features larger than 100 feet. It also means that a mountain top could be 99 feet higher in elevation than the map depicts.

Relief is a term which describes the change in elevation between two points. A topographic map which has a contour interval of 100 feet has a relief or a change in elevation, of 300 feet three contour lines away. If the horizontal distance on the map is scaled at only 300 feet as well, the land is changing elevation at a 45-degree angle.

Bathymetric maps or charts are topographic maps of the bottom features of a lake, sea, or ocean. They are very similar to topographic maps in their terminology and interpretation. The main difference between the two is that bathymetric maps show depth below sea level while topographic maps show elevation above sea level. Another main difference is the limited amount of data used to create a bathymetric map when compared to a topographic map. Because one cannot usually easily see beneath the water, the difference between what is mapped and the reality of what actually exists is much less exact in bathymetric maps. With the advent of new, more sophisticated ocean floor sensing technology, bathymetric maps are becoming much more detailed and revealing new information about ocean geology.

Exploratory research is being supported with funding from the National Oceanic and Atmospheric Administration's Office of Ocean Exploration along coastal waters of North America to make up for the deficiencies of resolution in older bathymetric readings and reveal the ocean bottom contour in much finer detail. Using the latest technology available, such as swath mapping systems, side-scan sonar, seismic reflection, and submersible and remotely-operated vehicle (ROV) dives, new and exciting details about the geology and the flora and fauna of the ocean bottom are being discovered. Resolutions of 5 meters at a depth of 120 meters are possible with this latest technology. Using a computer with a digital acquisition system, one is able to process the data and create three-dimensional views of the ocean bottom.

Some of the preliminary observations at nearshore depths reveal sea stacks, beaches, sea cliffs, lagoons, shore faces, wave cut platforms, and sand ripples, all formed 18-20 thousand years ago when large expanses of continental glaciers lowered the ocean levels to this previously-existing shoreline. Further exploration and mapping may reveal much more about climate, geological, and biological conditions that prevailed at the time, as well as insights into the indigenous people who would undoubtedly have taken advantage of the abundant resources available along the shoreline.

At depths further from shore, swath mapping systems, side-scan sonar, seismic reflection, and submersible and remotely-operated vehicle (ROV) dives are also being used to explore underwater volcanic rifts which encircle the Pacific Ocean. Many new discoveries and insights into the nature of this type of volcanism are being made, as well as its effects on the biological aspects of the region. More information about these discoveries can be found at http://oceanexplorer.noaa.gov/explorations/explorations.html. Through the Submarine Ring of Fire Expedition, scientists hope to reveal more about the volcanic rifts of the Pacific Ocean. Continuing the Lewis and Clark Legacy will inform you of the latest findings of high resolution bathymetric readings along the nearshore line.

Learning Procedure

Part I:

1. Introduce the lesson by drawing a large circular shape on the board. Ask the students what they think the drawing represents. All answers are accepted since it could be anything. Guide the answers, if necessary, toward maps of landforms, such as a pond or pasture outline, a race track circuit, and so on.

   When the focus of the attention is on the possible landform the circle represents, draw a side view of an undulating mountain directly below and matching the horizontal margins of the circle. Tell the students the two drawings represent the same thing, but from a different perspective. Ask the students again what they think the circular shape and the new side view of the circular shape represents. A mountain should be one of the obvious answers. Question the students further about which of these two drawings best represents a "map" of the mountain.

Which one best describes the altitude of the mountain? Which one best describes the circumference of the mountain? Is either "map" completely helpful to one who wants to know about the height and shape of the mountain? Is there a way to make a map that combines the two drawings into one?

2. Introduce the term topographic map and the need to design a type of map that allows one to know not just the distance of one place to another, but also how many hills and valleys one must traverse to go between the two places. A topographic map does this.

Part II:

1. Have the student groups gather the following materials:
   Container
   Rock or object
   Liter beaker of water
   Funnel
   Centimeter ruler
   Overhead projector acetate
   Felt tip marker
   Masking tape
   Scissors
   Activity directions
   Analysis Worksheet

2. Give a brief description of how to set up the equipment. Have the students follow the procedure page in setting it up. When the equipment is ready, have the students get your approval that it is set up correctly. It is best to have all setups complete and proceed as a class through the first drawing of the contour line where the object and the container bottom meet. This will ensure there are no questions about how to do it. Having completed the first contour line, have the class add water to the first centimeter mark on the ruler, reminding them to take care when pouring the water into the funnel. Remind them also about accuracy in measurement. Once they draw the second contour line they may work at their own speed.

3. When the topographic maps of the various objects are completed, have the students bring the maps to you. Have them place the objects they mapped on a counter or desk where all students can see the profile, or side perspective, of the object. Display overhead projections of the topographic maps of objects to the class. Ask the students which object on the counter each overhead projection represents. During this oral assessment of understanding, make sure that you show an overhead projection which is 180 degrees opposite in perspective to the view the students have of the respective object on the counter or desk. This not only tests the students understanding of topography with respect to the orientation of the object, but it is also a nice introduction or reinforcement of the value of compass direction being labeled on all maps.

THE BRIDGE CONNECTION

www.vims.edu/bridge

THE "ME" CONNECTION

Have you ever been lost in a store, in town, in the country? What is it that you look for to find your way back? A familiar landmark is what most people need to find. A topographic map is all about finding familiar landmarks even if you have never seen the landmark before.

CONNECTIONS TO OTHER SUBJECTS

Mathematics, Geography

EVALUATION

Teacher reviews topographic maps created by students for accuracy and understanding.

Teacher performs summative assessment by showing mapped objects and topographic map representations for class to relate to each another.

Teacher reviews worksheet assignment. Perform formative assessment test questioning on key terms and topographic/bathymetric interpretations.

EXTENSIONS

Have students find landmarks and important features on a topographic map of their own area. One may download a local topographic map from or purchase one.

Take a topographic map of the area where the next field trip will be taken. Have students locate where they are on the map, what elevation they are at, and what distance they are from a prominent landmark.

NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry - Content Standard A:

- Ability necessary to do scientific inquiry

Earth and Space Science - Content Standard D:

- Structure of the Earth system

Science and Technology - Content Standard E:

- Abilities of technological design

History and Nature of Science - Content Standard G:

- Nature of science

Activity developed by Bob Pearson, Eddyville School, Philomath, Oregon

Student Activity Directions

Materials: Make sure you have all of the following materials:

- Container
- Rock or object
- Liter beaker of water
- Funnel
- Centimeter ruler
- Overhead projector acetate
- Felt tip marker
- Masking tape
- Analysis worksheet
- Scissors

Procedure:

Read these instructions carefully. They contain new terms you will need for the Student Analysis Worksheet.

1. Place the centimeter ruler inside the container against a side wall near a corner. Make sure that the zero centimeter mark is at the bottom. Use the tape to attach the centimeter ruler to the container side, taking care not to make the measurement lines unreadable.

2. Place the object of your group's choice into the container with the flattest side facing down. Make sure no part of the object extends above the top of the container.

3. Cut the overhead acetate to a size that completely covers the container. On one corner of the acetate, cut away enough material so that the funnel spout can just fit through.

4. Tape the acetate to the top of the container. Attach the tape only at a few edges of the overhead and not completely across the container opening. You will need to remove the acetate later so use only enough tape to hold it firmly.

5. Insert the funnel into the opening and tape it so it is securely in place.

6. Check your setup for approval by your teacher.

7. When told to do so, view the object by placing your eyes directly above it looking downward. Focus on the outline of where the container and the object meet. Using the felt tip pen, very carefully draw this outline on the acetate, making sure that the end of the outline meets with the beginning. The line that you draw is called a "contour line."

8. Take the beaker of water and carefully add water through the funnel until the water level rises to the one centimeter mark on the ruler. Again, look directly downward at the object. Focus on where the object and water line meet. Draw this contour line in the same way you drew the first one, but following the line where the water meets the object. You now have two contour lines which represent a one-centimeter rise in elevation. Anytime there is a change in elevation between two points, there is a change in "relief." The one-centimeter change in relief between two adjacent contour lines is known as the "contour interval."

9. Continue adding water at one centimeter intervals and drawing the contour lines at each centimeter rise as described in procedure No. 8 until the object is completely covered with water. When you are finished, you will have a topographic map showing the elevation of the object with one centimeter contour intervals.

10. Obtain a Student Analysis Worksheet and answer the questions.

11. When told to do so, carefully remove the overhead acetate from the container and give it to your teacher. Clean up and put away the other materials in their appropriate place.

Student Analysis Worksheet

1. What is the name of the type of map you just created?

____

2. What is the name of each continuous line that was drawn?

____

3. How does the distance between two contour lines relate to the rise in elevation of the object? What is the term used for a change in elevation between two points?

____

____

4. What is the name given to the elevation rise between two contour lines?

____

5. If the distance between two contour lines is very close, what does that mean about the slope of a hill or mountain?

____

____

6. If the distance between two contour lines is far away, what does that mean about the slope of a hill or mountain?

____

____

7. Look at the topographic map you have made and determine the height, in centimeters, of the object. Remember, the first contour line you drew was at zero centimeters. How high was your object according to the map? What is the change in relief?

____

____

____

8. Measure the height of the object with a ruler. How high is the object with the ruler? Are these heights the same?

____

____

9. Do you think that a topographic map will always show the correct height of a mountain or hill? Explain why or why not?

____

____

____

10. Imagine that the object you just mapped was underwater, like it was when you finished mapping it. Do you think topographic map techniques could be made of an underwater mountain or canyon? Why or why not?

____

____

11. A topographic map of the bottom of a body of water is called a "bathymetric" map. If the object you just mapped was underwater, and the top of the object was at zero feet below water, what could each contour interval represent in water depth?

____

12. How deep in centimeters would the bottom of the object you mapped be if the top of the object was right at water level?

____

12. What point in the world do you think the zero contour line begins for topographic and bathymetric maps?

____

13. Compare and contrast topographic elevation with bathymetric depth.

____

____

NOTICE

Reproduction Basis

☐ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

X This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").